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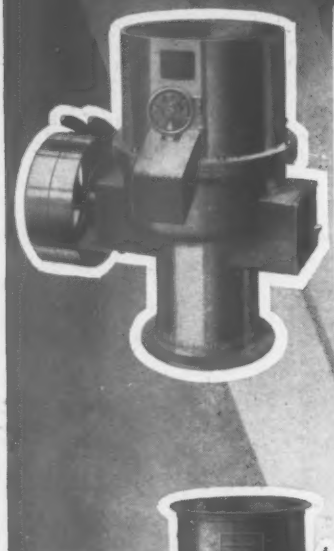

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FOUNDRY TRADE JOURNAL
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Vol. 69 Thursday, April 8, 1943 No. 1390

Humidity and Blast Control

Most competent foundry foremen will agree that atmospheric conditions profoundly influence both cupola operation and the resulting metal. In how far operating conditions and consumption figures are affected by the variations in atmospheric moisture, has exercised the minds of cupola operators for many years. Much consideration has been given to the subject in the United States, and the "Iron Age," in its annual review of developments in foundry practice, singles out the work of the Battelle Memorial Institute, which, by means of a graph, showed the quantity of extra coke needed to compensate for losses introduced by increased atmospheric moisture content, as being particularly important. Naturally enough, if the coke to iron ratio is disturbed, then the composition of the metal is altered, and Mr. Cowan, in an article reproduced elsewhere in this issue, reports, with increasing moisture content, a decreasing total carbon and silicon content and an increase in the combined carbon. This, of course, has a profound effect on the microstructure.

Then Mr. L. W. Bolton, in our correspondence columns, points out that the hydrogen-producing endothermic reaction consequent upon the injection of moisture with the blast at the tuyeres theoretically reduces the working temperature at the very place where it is most needed. Yet Mr. Bolton concludes that normal variations have no appreciable effect on metal temperature, but suspects what Mr. Cowan has proved an "increasing tendency to chill"—that is, a higher combined carbon content. Herres and Lorig, however, advise that "where a critical type of casting is being manufactured . . . compensation for humidity changes should be made." It seems desirable at this stage to pose the question as to whether atmospheric variations are of a wider range in the States than in Great Britain. We ask this because it appears to us that the Americans are attaching very considerable importance to the ill-effect of atmospheric moisture variation on furnace practice in general. Naturally, the blast furnace is having the place of honour in the news, and such a phrase as the "Kathabar system (of air conditioning) has for several years been installed on foundry cupolas," shows that there exists a body of opinion which is testing out its notions by long-term trials. Air is used in very large quantities in cupola practice. A ton, we are told, contains about 600 lbs. of oxygen and between 50 and 100 lbs. of moisture. Thus, nineteen blast furnaces in the United States having a choice of four commercialised systems are provided with apparatus designed to control the moisture at a low standard figure, and the favourable results expected from the Bethlehem and Inland plants will quickly more than double the number of American installations. The use of a dry blast is said to increase output beyond the theoretical concept. James Gayley, in 1904, reported an increased production of 12 per cent. associated with a 10 per cent. decreased coke consumption. For the control of cupolas, there seem to be two avenues of approach; one is to control the blast delivered to the furnace *vis-à-vis* the barometric pressure, and the dry-bulb reading as was shown by Herres and Lorig, or to pass the blast through an apparatus which will control the moisture content at 1 or 1½ or 3 grains per cub. ft. On scientific grounds, we prefer the latter proposition, though the former has much to commend it.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

HUMIDITY AND BLAST CONTROL

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to the letter on the above subject which appears in your issue of March 18, your correspondent is correct in assuming that the difference in the free oxygen content of a given weight of dry and saturated air does not, even under extreme conditions, exceed about 1.5 per cent. Variations in oxygen content due to moisture in a constant volume of air are small compared with those due to normal differences in temperature and barometric pressure. In many foundries, however, variations in the weight of air supplied to the cupola, due to atmospheric changes, have no noticeable influence on melting efficiency, as the amount of air delivered is adjusted to suit a variable demand for metal.

To assume that moisture in coke has more effect on cupola operation than a damp air blast is not entirely correct. Moisture put into the cupola with the metal, coke and flux charges is rapidly driven off by the ascending hot gases, and as these normally contain more sensible heat than can be taken up by the descending charges, the heat loss in evaporating this moisture is negligible.

Moisture injected at the tuyeres with the air blast reacts with the strongly heated coke in the bed as follows: $C + H_2O \rightarrow CO + H_2$, accompanied by a loss of heat which for coke at a temperature of 1,600 deg. C. is of the order of − 5,800 B.Th.U. per lb. of carbon so oxidised. Even if it is assumed that the carbon monoxide and hydrogen formed in this way are burned to produce heat in the higher zones of the furnace, the fact that an endothermic reaction is taking place in the zone where the metal acquires its superheat will theoretically, other conditions being constant, reduce the tapping temperature of the metal.

Actually, in practice, the coke to metal ratios employed on many cupolas are such that normal variations in the humidity of the blast have no appreciable effect on metal temperature. Cases have been met in cupolas operated at a very economical metal-to-coke ratio, where on days of exceptionally high humidity the tapping temperature has been lower than normal. In the writer's opinion, it is more likely that this lower tapping temperature has been due to the reaction described above than to differences in barometric pressure.

The hydrogen released when appreciable quantities of moisture are injected into the bed of a cupola may influence the properties of the metal melted by increasing tendency to chill, etc., but it is possible that your correspondent is not concerned with this aspect of the problem.—Yours, etc.,

L. W. BOLTON.

The British Cast Iron Research Association,
Alvechurch, Birmingham.
March 29, 1943.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to Mr. H. A. Hallett's letter in your Correspondence column of March 18, as fully described in Papers published in this JOURNAL and I.B.F. Proceedings, 1939-40, Nos. 711 and 726, I have carried out a great deal of experiment and measurement on the effect of moisture in the blast on the quantity and composition of dissolved gas in the melted metal, and also on the composition of the metal itself.

The quantity of water entering the cupola in the blast from day to day was found to vary very considerably, and must have a considerable effect, particularly on certain types of cast iron of the high-duty type.

That there are other sources of dissolved gases which vary more, especially in poor melting practice, does not make the humidity less important. No doubt these variables will be gradually removed in future practice by all-round improvements in the technique, particularly as the knowledge of this subject continues to increase.

If Mr. Hallett has not already seen these Papers, he might find some helpful information therein, although so far the work described has not been covered elsewhere.

Further additions to the very scanty knowledge of this phase of cast-iron metallurgy would, I feel sure, be very welcome.—Yours, etc.,

WM. Y. BUCHANAN,
Foundry Manager.

John Lang & Sons, Limited,
Johnstone.
March 22, 1943.

[This subject of the effect of moisture control in the foundry cupola was discussed by S. A. Herres and C. H. Lorig in our issue of August 6 last, and a further article, by R. J. Cowan, is published in this issue.—EDITOR.]

INDEX TO VOL. 68

The Index to Vol. 68 of the FOUNDRY TRADE JOURNAL, covering September to December, 1942, inclusive, can now be obtained, on written application, from the Publishers at 3, Amersham Road, High Wycombe, Bucks. The Index to the current volume, which will end with the issue of April 29, is in preparation, and should be requested at the same time as applying for the Index to Vol. 68.

"Substitutes"

A new book, "Substitutes," by H. Bennett, published by the Chemical Publishing Company, Inc., Brooklyn, N.Y., appeared in January. It describes new products, processes and materials to be used as alternatives for several raw materials which have become unavailable because of the war. Substitutes for metals, plastics, chemicals, paints, oils and other products are discussed in this volume.

ACID RESISTANCE AND TECHNICAL CONTROL IN AN ENAMELLING PLANT*

Advantages of Vitreous Enamel—Step-by-step control and testing ensures first quality products

By W. MONTGOMERY†

Generally speaking, acid resistance, as defined in this country, is a purely relative term. To some it means resistance to attack by industrial atmospheres, to others, resistance to the action of organic acids—mostly fruit juices; while to a select group of enamellers it infers the complete passivity of an enamel to most known acids, organic and inorganic. In this Paper, the term "acid resistance" with reference to vitreous enamel implies that the material is inert to the action of all organic and mineral acids, with the exception of hydrofluoric acid and its salts, and possibly phosphoric acid of certain concentrations.

Such a material has valuable attributes which, in some cases, make it superior, in the field of chemical resistance, to even the modern synthetic resins or plastics. All these latter substances are soluble in some organic liquids, which limits their range of usefulness to the chemical trade. Metals of the "stainless" type also show excellent resistance to the corrosive action of certain chemicals, but, of course, the scope of their applications is limited, while in the present emergency the limiting factor is often the imperative need to conserve valuable metals.

Thus, from the chemical engineer's viewpoint, some materials cannot be considered, others have limited applicability, and a few stand high in his estimation as giving chemically-resistant engineering surfaces. In this latter category falls acid-resisting vitreous enamel. When suitably produced, these enamels are astonishingly resistant to corrosive conditions and are being increasingly used in the chemical, pharmaceutical, food and allied trades where freedom from contamination of the product is essential.

FIG. 1.—FABRICATING SHOP FOR GLASS-LINED VESSELS.

Some Advantages of Vitreous Enamel

In a reaction vessel where a chemical may be precipitated or in a tank in which milk is stored, it is a decided advantage to be able to clean out the container regularly and efficiently. With a glass-lined vessel such an operation is simplicity itself. Contamination of the product is, for all practical purposes, virtually eliminated as the solubility of these boro-silicate glasses or vitreous enamels in acids of all concentrations is negligible. The heat transfer characteristics of these enamels are of a high order. Rubber linings, plastics and cements often leave much to be desired in this connection.

In spite of being relatively brittle and non-ductile, these enamel linings in steel and cast-iron vessels will withstand a surprising amount of abuse, although, it need hardly be said, the wise user of a glass-lined vessel will not drop a 10-lb. hammer on to its surface. Actually, the strength of a composite is determined by the strength of the bond, and this factor is well known to be quite satisfactory in a well-balanced enamel properly fused on to a metallic base. Quite rightly, the appearance of vitreous-enamelled ware is often stressed and it may be stated that in developing the utilitarian properties of the enamel, the æsthetic side need not be neglected. High gloss and good finish are necessary prerequisites in acid-resisting enamel glasses. Fast pastel colours are usually used while the ubiquitous mottled finish is, for obvious reasons, dispensed with.

The broad principles of applying these silicate coatings to metals are, of course, widely understood, but into the processing of acid-resisting enamels, on an industrial scale, there creeps certain difficulties. The glass (and these silicates are true glasses) is usually

* Paper read before the Falkirk Section of the Institute of British Foundrymen on January 29, 1943, Mr. G. Wilson presiding.

† Chief Chemist, H. Balfour & Co. Ltd., and Enamelled Metal Products Corporation.

Technical Control in Enamelling

more viscous at firing temperatures, and hence less easily "worked" than the lead-bearing porcelain enamels. A certain degree of ease of application is sacrificed in attaining good resistivity. These practical difficulties are overcome in plant operation by the application of rigid technical control and the imposing of a standardised procedure at every stage of the process. Designers of enamelled ware must co-operate fully with the works personnel, as well as with the laboratory.

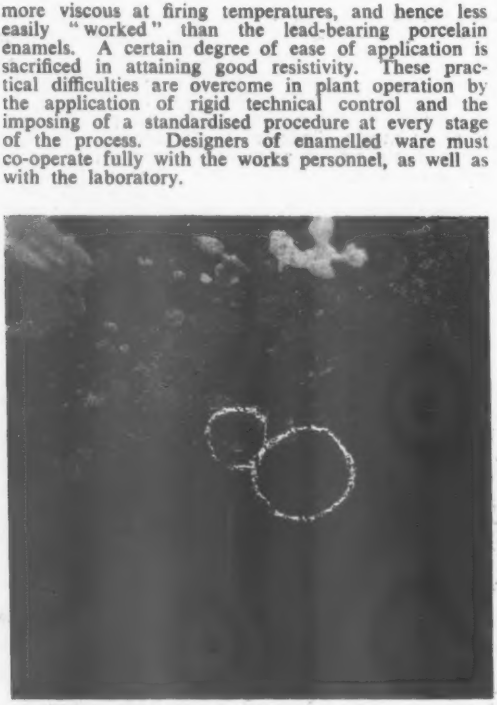

FIG. 2.—STEEL SURFACE FLAWS.

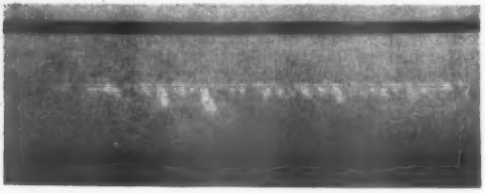

FIG. 3.—RADIOGRAPH OF BAD ENAMELLING WELD.

Scientific investigations have contributed as much to the glass and enamel industries as to any other industrial development. Although the industry has progressed a long way beyond the primitive efforts of the early Chinese or Egyptian enamellers, it would be untrue to say that modern scientific control has entirely eliminated the personal equation from the enamelling plant. The practical enameller is still a craftsman and in the final count it is his work which makes or mars a job, although most of the empirical practices have been eliminated.

Composition of Base-Metal

The choice of the base-metal may be either steel or cast iron, the governing factors being size, weight, and design of vessel. In the case of steel, technical control starts with the careful choice of raw material. Acid open-hearth steel is demanded with a maximum carbon content of 0.15 per cent., and other impurities in the stock used must be as low as practicable. Cast-iron enamellers might well ask why such a low carbon content is specified for steel enamelling stock, when they are regularly using irons with over 3.0 per cent. carbon.

It must be realised that, apart from dissolved gas, slag and oxide inclusions, the main factor governing the ability or a steel to take an enamel is its microscopic structure; taking 0.83 per cent. carbon as the eutectoid composition, and remembering that one part by weight of carbon yields approximately 15 parts of cementite, and that 1 part of cementite is equivalent to 8 parts of pearlite, it may be seen that the microstructure of a 0.15 per cent. carbon steel will reveal 18 per cent. pearlite and 82 per cent. ferrite. Given the above percentage of pearlite, 2.25 per cent. of iron carbide would be present.

Using similar reasoning it will be noted that a steel containing 0.50 per cent. of carbon will in the microstructure show 60 per cent. of pearlite, the remaining 40 per cent. consisting of free ferrite, taking for granted, of course, that equilibrium conditions prevail. The point to be emphasised is that with a small increment in carbon percentage a relatively larger increase in the amount of pearlite present may be expected. In steel, the presence of appreciable quantities of pearlite always leads to enamelling troubles. Even ignoring the increased volume change which it gives rise to at the eutectoid temperature, it can be accepted as fact that the presence of eutectoid iron carbide at temperatures slightly under 700 deg. C. causes blistering on the enamel layer. Without entering into a detailed discussion of these phenomena, it may be stated that iron carbide may be oxidised by moisture in the enamel slip to form either hydrocarbons or molecular hydrogen, depending on the decomposition temperature. Hydrocarbons break down completely at about 600 deg. C., and hydrogen may be liberated in quantity at the enamel-metal interface.

Technical Control in Production

To illustrate how technical control plays a part in every operation, a brief resume will be given of the sequence of production from steel plate to finished vessel. The design and size of the latter make mild steel the natural choice for the enamel base in the majority of these articles. It can be taken for granted that the rigid control in the operations described hereafter are just as applicable to, and in some cases more necessary for, cast-iron enamelling.

It is stipulated that all steel enamelling stock must be under 0.20 per cent. carbon and be produced by the acid open-hearth process. The chemical composition is carefully checked by the laboratory on all incoming materials and, quite apart from the carbon content mentioned above, the minimum of impurities must be present. A view of that section of the boiler-shop where enamelling stock is fabricated is shown in Fig. 1. The plates are cut, shaped, and welded here after inspection to ensure the absence of cracks, laminations, rolled-in mill scale, and any similar extraneous flaws. A small undetected lamination in a plate at this stage assuredly leads to enamelling difficulty at a later period. Fig. 2 shows the type of surface flaw which must be eliminated. Small round pieces of slag or oxide were rolled into the hot plate at the mills; the pieces can be readily picked out, but the little cavities left cause trouble out of all proportion to their size.

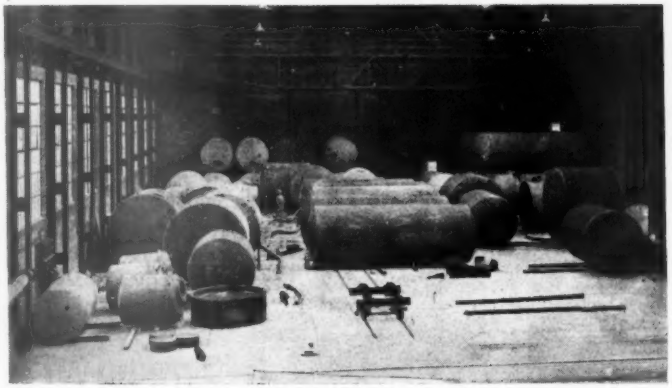

FIG. 4.—ENAMELLING SHOP (WET-SPRAY METHOD).

One of the most prevalent causes of enamelling defects is to be found in "gassy" welds. Where the weld deposit has failed to penetrate to the root, cavities are formed which favour the enclosure of trapped gases. As these inclusions are always below the surface of the metal, it can only be deduced that diffusion of the gas to the surface has taken place at the high enamelling temperatures involved. The author believes that hydrogen is mainly responsible. For the inspection of welds in enamelling vessels radiography has proved a boon. Radiographs taken on a seam after welding may save much time and money in blasting, furnacing and enamelling by continuing to process faulty material. X-ray examination of each seam eventually became unnecessary in the author's plant as the welders, with X-ray aid, perfected their technique until only investigational work called for radiographs. Fig. 3 shows a typically poor weld from the enameller's viewpoint.

The fabricated components are next given a preliminary normalising treatment at the enamelling temperature which relieves stresses in the metal, and those due to previous rolling and welding operations. Dissolved gases may, at this stage, be diffused to the surface and partially expelled, while surface grease and oil are burned out.

The parts then pass to the sand-blast chamber, where control of the operations aids greatly in maintaining a steady throughput. Quartz grains are used in preference to chilled grit and this, naturally, entails the inclusion in the plant of protective measures for the operatives. Much has been written about the principles and technique of sand-blasting but this particular unit is of the modern automatic type in which the fines are separated from the used grains and the latter returned, after screening, to the main chamber. Medium or low blast pressures are used to prevent undue shattering of the sand particles. The size and shape of the grains are controlled from day to day by laboratory sieve tests and microscopic analyses. This sand-blast chamber also plays an important part in de-enamelling operations. The nature of the work precludes the use of alkali baths in this connection and enamelled surfaces usually receive, while hot, a spray quench prior to sand blasting, as this renders the enamel friable and easier to remove.

In the main enamelling shop, shown in Fig. 4, the vessels are sprayed for firing and fitted for despatch. A supply of hot air is drawn from recuperators on top of the furnaces and led through conduits into the sprayed tanks in order to drive the moisture from the slip as quickly as possible. Fig. 5 shows a sprayer manipulating a compressed air spray-gun inside a vessel, and although the man is aided by having scientifically set-up enamel, quite a modicum of skill is required to apply the wet slip in such a manner as to avoid trouble in firing. He knows just where the enamel should be applied a little thicker; where it is necessary to have fine and even application; and, above all, to detect any surface blemishes and remove them prior to the application of a ground coat.

Furnacing

The factory with which the author is associated possesses the finest enamelling furnace of its type in the country. Vessels can be accommodated up to an overall size of 20 ft. in length and 12 ft. diameter. Such a tank would weigh approximately 9 tons and have a capacity of 15,000 galls. As an approximation, it may be stated that 4 tons of trebles will provide enough producer gas to fire 10 tanks weighing 3 tons each to a temperature of 890 deg. C. from room temperature in about 5 hrs. These data make

Technical Control in Enamelling

allowances for heat lost in removing and recharging the ware and it will be obvious that in spite of the large radiating surface the furnace has attained a surprising degree of efficiency.

One unusual feature lies in the method of charging. The furnace chamber is considerably above floor level and the rotatable bottom is raised and lowered by means of a hydraulic ram. The temperature is closely controlled by thermo-couples placed at strategic points in the firing chamber while optical pyrometers, sighted on to the surface of the tank, being annealed or enamelled, indicate when the charge has attained the desired temperature (Figs. 6 and 7). For long it was

FIG. 5.—SPRAYING A VESSEL.

considered necessary to protect enamelled ware from the effects of furnace gases by using only the muffle type of furnace but the better understanding, which comes from careful investigations, has shown that by controlling the furnace atmosphere and eliminating deleterious gases, it is quite reasonable to process in the reverberatory or direct-fired type. For this reason the management, at Leven, installed an automatic gas recorder which, in graphical form, indicates the concentrations of carbon dioxide, carbon monoxide and free oxygen present in the furnace atmosphere at any given time. The accuracy of this instrument is periodically checked by laboratory analyses.

Smaller work, done by the hot-dusting process, obviously demands processing in the muffle type by reason of the intermittent nature of the firing (Fig. 8). Muffle furnaces are most inefficient and wasteful from the heat-transfer point of view. So many heat units are lost in heating firebricks that it is highly important to give due consideration to design, materials and proper insulation when installing this type. As there is little transfer of heat by convection, reliance must be placed solely on radiant heat to fire out the ware, hence the necessity of carefully planning the purchase of refractories.

The thermal conductivity of the muffle floor and walls adjacent to the combustion chamber has an

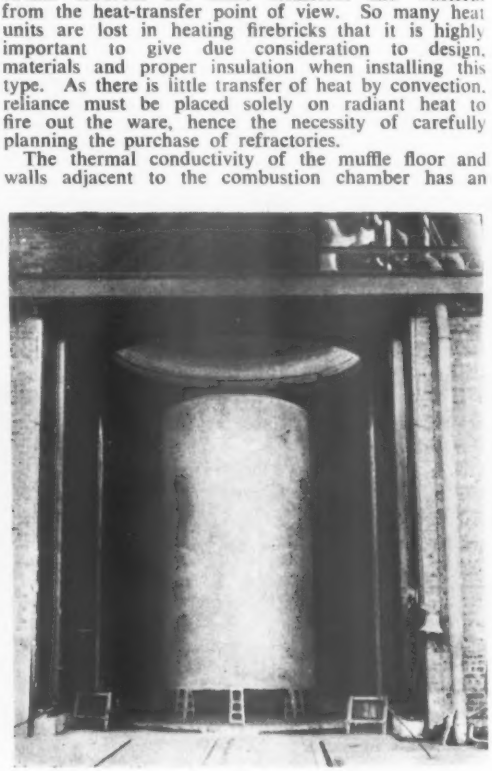

FIG. 6.—REVERBERATORY FURNACE, FLOOR LOWERED.

important bearing on fuel costs and general efficiency. So far as modern oil-fired furnaces are concerned it is strongly recommended that silicon carbide bricks be used in these parts. The thermal conductivity of this material is over 100 in the region of 1,000 deg. C., and this is many times greater than that of aluminous firebrick. Its only disadvantage is that it tends to oxidise in the temperature region of 800 to 1,000 deg. C. (due to the opening and shutting of the furnace door repeatedly) and flaking may result.

The intensely hot oil flame gives high combustion chamber temperatures and those parts of the structure which receive direct flame impingement become very hot indeed. While firebricks with a high alumina content are often employed, in personal experience it was found that they did not allow a sufficient margin of safety when used at the high temperatures attained

in a modern furnace, and that under severe conditions squatting and spalling occurred in a very short time. A volume-stable, highly refractory material with good thermal conductivity, is surely called for and these desirable qualities are met by fused alumina bricks. The higher initial cost of these materials is always offset by the structural stability and longer life secured. For the sides of the furnace structure where the temperature is lower, aluminous firebricks (50 per cent. Al_2O_3) serve quite well, while for less exposed parts ordinary Scottish firebricks serve the purpose.

FIG. 7.—REVERBERATORY FURNACE, FLOOR RAISED.

Often, it proves a wise step to insulate the furnace with a layer of magnesia insulating bricks. A saving of fuel can often be effected by preheating the air supplied to the burners or, as is done in the plant under discussion, using the hot air to dry out the sprayed ware. Pyrometric control is used, as before, to aid the enameller to fire out the vessels. In hot dusting, though, the first prerequisites are good judgment and experience.

Mill Room

When trouble arises in the shops there seems to be a phobia among executives which gives them an urge to trace the illness back to the mills. This attitude is often justified, but the author's firm, believing that prevention is better than cure, insists on a rigid technical control being applied to milling and mixing processes. Mixtures, milling times and temperatures are all closely standardised, which means that routine tests must be carried out on every batch of enamel slip delivered from the mills in order to keep the properties within specified limits. Fineness, water content, specific gravity, mobility and yield value are the constants regularly determined. Of these tests, the first three are commonly carried out in most plants. The fineness is usually determined by screening the slip through graded sieves, and expressing the results as the number of grammes of material retained on a mesh of definite size. The water content can be rapidly gauged on the plant, by carrying out a specific gravity determination on the slip and at the same time knowing, or at least assuming, the value for the gravity of the solids in the enamel.

The flow of matter can be divided into two categories—plastic flow and viscous flow. Viscous flow is the characteristic of a true fluid and viscosity is one of the important constants used in making a comparison of the properties of such fluids. If a cup with an orifice in the bottom is filled with a viscous liquid, the latter will flow through the orifice without regard to the hydrostatic head. On the other hand, a plastic material must have a definite force to start flow by overcoming inertia, and this force is termed the "yield value." The rate of flow which occurs when this value is exceeded is termed the "mobility."

FIG. 8.—MUFFLE FURNACE SHOWING AN ANCHOR-TYPE STIRRER BEING DUSTED.

(To be continued.)

Brazilian Economic Co-ordinator J. A. L. de Barros has stated that Brazil, with United States assistance, plans to establish in Brazil an aluminium manufacturing plant with a capacity of 25,000 tons annually. He explained that Brazilian bauxite was of high quality. It was planned to make shipments of bauxite to the United States of 1,000 tons monthly.

American Metallurgical Scene—12

THE FOUNDRY INDUSTRY IN 1942

The importance of castings as basic engineering materials for the construction of implements of war was demonstrated conclusively during the past year, states "Steel" in a review of the American foundry industry in 1942. As programmes for the production of tanks, guns, planes, ships, trucks, machine tools and the other war needs were accelerated, enormous demands for various types of castings were directed at the foundry industry. By the conversion of facilities to meet particular requirements of the war effort, through expansion of plants or the construction of new foundries when existing capacity was not sufficient, and most of all, through applying ingenuity and experience to the production of greater quantities of castings with the plant and equipment available, foundrymen have had a great part in the achievements of American industry since Pearl Harbour.

The outbreak of war found American steelfoundries already loaded with high priority work, and new demands, especially for tank castings, added to the backlog of orders. During the past 12 months new steelfoundries have been completed, many plants have been expanded and a number of grey iron and malleable iron foundries have been converted to the production of steel castings through installation of converters or electric furnaces and the necessary heat-treating equipment. It is estimated that the capacity for producing steel castings was doubled during the past 20 months.

Grey-iron foundries have increased materially the production of machine tool and other machinery castings since war was declared in December, 1941. However, shortages of pig-iron and scrap, brought about by war production, resulted in limitation orders which stopped all civilian production early in the year and left many manufacturers of grey-iron castings facing heavy curtailments in operations. By converting facilities and personnel to the production of those types of grey iron in which war demands exceeded production capacity, by developing new applications for grey iron in the war effort, and by converting to the production of other types of castings, such as steel, aluminium and magnesium, the great majority of grey-iron foundries have continued to render great service to the war effort.

The malleable foundry industry has been doing an excellent job in assisting various departments of the government in the problem of substitution of malleable for other war materials more difficult to obtain. As a result of this work, the demand for malleable iron for war work continues to gain.

In the non-ferrous field, most brass and bronze foundries have been successful in converting to war work, and the remainder, due to shortages of metals, have had to close. In the field of aluminium and magnesium castings, an accelerated expansion of facilities is under way. Both brass and iron foundries now are revamping facilities to produce light metal castings, and numerous entirely new foundries are being rushed to meet the needs of the greatly expanded plane programme for 1943. Producers of foundry equipment set an all-time record in 1942.

What is the outlook for the foundry industry in 1943? This depends entirely upon the demands of the Armed Services, as created by the developing offensive campaigns. An indication of this is to be found recently when shifting of production emphasis has had a pronounced effect upon the foundry industry. Doubling the airplane programme has provided a heavy expansion in foundries to produce aluminium and magnesium castings. On the other hand, efficiency of plants producing tanks and tank parts has been so high that a number of steelfoundry projects, many well along toward completion, have been held up. As this shifting of emphasis continues, foundries must be able to apply facilities to new production problems, as now is being done in the aluminium and magnesium fields.

American shipyards built 625 vessels of 6,890,000 deadweight tons in the first eleven months of 1942.

The War Production Board has issued a further Order setting up a new concentration division to concentrate U.S. production still more in 1943.

General Motors is now producing war materials at a rate of more than $8,000,000 a day, and the figure is still growing. Total deliveries of war materials for the first ten months of 1942 were $1,452 million, compared with $406 million for the whole of 1941.

Bohn Aluminium & Brass Corporation, Detroit, have formed a new branch, to be known as the Aluminium Refiners' Division, to specialise in the refining of aluminium scrap into aluminium alloy ingot. Furnaces and auxiliary equipment for the refining of scrap aluminium have been installed and the plant was scheduled to be in operation by March 1.

The first steelworks on the U.S. Pacific coast has begun production within nine months after its construction had been approved by Washington. Situated at Fontana, California, its estimated output is 675,000 tons of steel ingots a year. The rolling mill will handle 300,000 tons of ship plates a year, enough to build 120 full-sized merchant ships. All raw materials necessary for production are mined locally. The works are a further achievement of Mr. Henry J. Kaiser.

To expand American vanadium output, the Metals Reserve Company has undertaken a programme for rapid development of the sandstone ores of Western Colorado and Eastern Utah, and two new mills are now in operation in this area. A similar programme is under way in connection with lead vanadate ore in Nevada. Research is being financed on several additional potential sources of vanadium. It is estimated that with the above steps, production in 1943 will be more than double the 1941 domestic output. The Defense Plant Corporation has authorised commitments totalling $1,260,000 for the production of vanadium and vanadium pentoxide.

EFFECT OF MOISTURE IN CUPOLA OPERATION*

By R. J. Cowan

It is a matter of common knowledge that the operation of a foundry cupola is dependent upon the weather. If the day be a dry one, the air entering the cupola will be low in moisture, and this will have a beneficial effect upon the operation. On the other hand, if the moisture content of the air is high, the operation of the cupola is adversely affected. These facts in themselves are responsible for many of the ups and downs encountered in cupola operation. During the winter time, the moisture content of the air is usually low, and this checks with the common observation that the operation of these units is more uniform in winter than in summer.

During the summer season, the moisture content of air suffers a wide series of fluctuations that often occur rather suddenly and, at times, during the course of a single day. These changes often result in upsetting the cupola operation. This fact is so well recognised that it has become good practice in the operation of cupola plants to take periodic moisture readings of the air used in the blast. On the basis of this content an adjustment is made in the coke charge along with the necessary volume change in the amount of air used.

The procedure requires constant attention and supervision to ensure satisfactory results. Thus, it is obvious that the best type of cupola operation is obtained under conditions that are maintained uniform at all times. When it becomes necessary to change any of the factors, such as air, fuel, burden, etc., the functioning of

* Extracted from a Paper "Effect of Moisture in Blast Air."—"Iron Age."

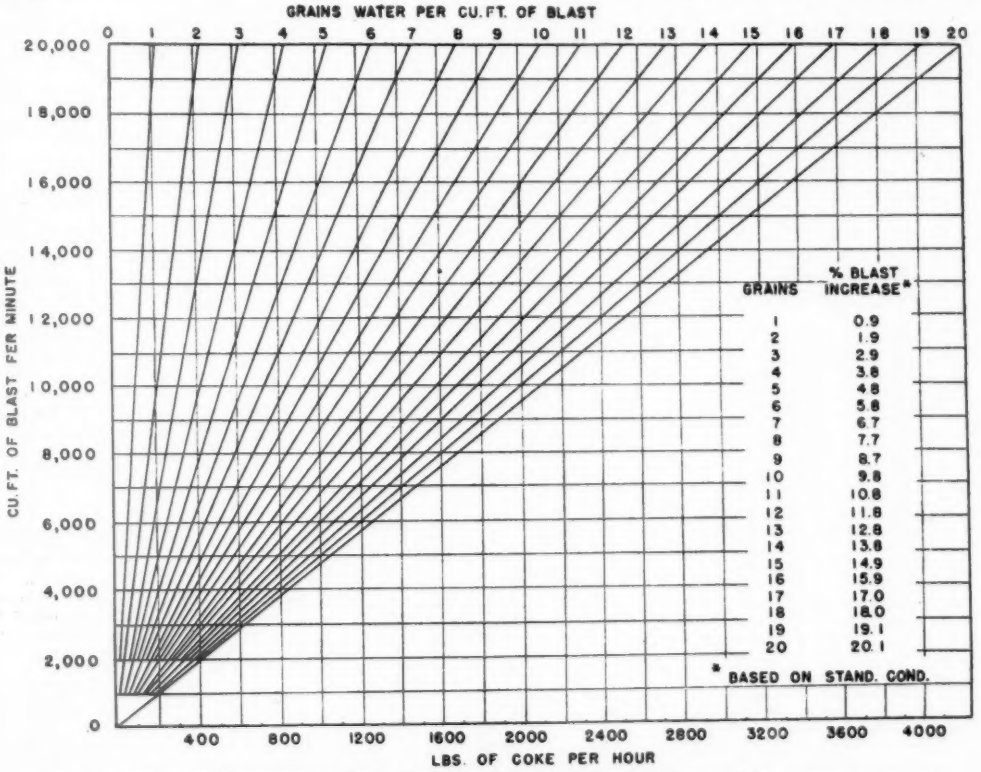

Fig. 1.—Effect of Moisture on Coke Consumption, showing Amount of Coke which must be added to the Base Charge to compensate for a Given Increase in the Moisture Content of the Blast.

Effect of Moisture on Cupolas

the cupola is altered and time is required to stabilise conditions on the new basis.

However, if these changes are made frequently throughout the run, as is sometimes found to be necessary when the moisture content of the blast varies, it is obvious that, while the results may be kept satisfactory from the standpoint of metal quality, this will have been accomplished at the expense of considerable adjustment. Always present is the danger of producing iron of intermediate or indifferent quality. In fact, these frequent adjustments are largely responsible for the production of off-quality metal.

Coke Consumption

The amount of moisture in the cupola blast affects coke consumption in a very definite manner, acting to increase coke requirements as the moisture content of the blast rises. A chart, prepared by the Battelle Memorial Institute, shows the amount of coke that must be added to the base charge to compensate for a given increase in moisture content of the blast.

TABLE I.—*Effect of Moisture on Chemical Analysis of Grey Iron.*

Heat No.	Grains of moisture, per cu. ft.	T.C.	C.C.	Mn	P	S	Si
17	21.2	2.64	0.95	0.70	0.136	0.103	1.42
18	10.4	2.92	0.82	0.83	0.144	0.102	1.58
28	1.5	2.99	0.71	0.79	0.122	0.144	1.77

This chart is read in the following manner, assuming a cupola requiring 11,000 cub. ft. of air per min. If this air contains seven grains of water per cub. ft., coke to the amount of 800 lbs. will have to be added to the base charge. If this blast contains 10.5 grains, 1,200 lbs. of coke will be required, in addition to the base charge.

The fluctuation of the moisture content of the air in actual practice can be very sharp. A variation of 6 to 10 grains per cub. ft. may be observed between different days and occasionally within the same day. It is apparent from this chart that an increase in the moisture in the blast requires an increase in coke charges in order to maintain the metal temperature. This has a far-reaching effect upon the entire operation. In the first place, it will supply additional carbon to react with the oxygen of the water and, since heat is necessary to produce this reaction, this will affect the temperature of the metal. The varied temperature, in turn, will alter the chemical composition of the metal being produced.

The effect of moisture upon temperature may be illustrated in many different ways. In the operation of the Bessemer converter, steam is sometimes added to the air blown through the molten metal to hold down the temperature of reaction. And, in certain experiments in the melting of malleable iron, the effect of moisture added to the blast of a reverberatory furnace has served to lower the temperature of the resulting iron. The effect was the same when moisture was added to the coal used for fuel, either as additional moisture or as moisture locked in the structure of certain types of coal.

To illustrate the effect of moisture upon the chemical analysis of grey iron, the result of a run in a cupola in which all conditions were maintained constant, except the moisture content of the blast, is shown in Table I. The table shows that as the moisture content increases, the total carbon content of the metal decreases, the silicon content decreases and the combined carbon increases considerably. These facts indicate that the iron has increased substantially in hardness.

The wide difference in the microstructures, as a result of the different moisture contents of the blast, is a clear illustration of the effect that moisture has on the operation of a cupola and the resulting product. Records show that the temperature of this metal was lowered, as a result of the increase in moisture content, from about 1,415 to 1,360 deg. C. with the higher moisture value. This lower temperature affected the melting rate adversely.

In another case a manufacturer of piston rings found that the rings became white and hard when the moisture content of the blast increased above a certain minimum. An increase in the moisture content of the blast from 3 to 10 grains per cub. ft. was sufficient to cause differences in these rings, clearly shown in micrographs.

It is not intended to convey the impression that variations of this kind are to be looked for in castings coming from grey-iron foundries. The men who operate cupolas know how, by manipulation, to take care of these variables, and it is a part of the art of cupola operation to detect as quickly as possible the adverse developments as they occur and to make adjustments necessary to compensate for them.

There are times, however, when this is extremely difficult and at all times its success is dependent upon the personal element, a most variable factor. These variations can be met and maintained in a far simpler manner by controlling the moisture content of the blast and holding it at a definite value which has been determined by experience. Such a procedure can be established very simply.

Glass Fibre Insulation on Brass Furnaces

With mica listed as one of America's critical materials, the Western Cartridge Company has successfully used "Fiberglas" tape in place of mica as coil insulation in the primary coil of induction-type brass furnaces. It is said that the use of this insulation makes it practicable to increase furnace temperatures to the point where it was possible to produce five pours of 1,500 lbs. each during each 8-hr. shift, whereas with the mica insulation the limit was three pours of 1,500 lbs. each during each 8-hr. shift. The cost of the glass insulation was 50 per cent. less than the mica it replaced. The number of man-hours required to install the insulation was less than half that required for the installation of mica. Approximately 1,000 induction-type furnaces are used by the large brass companies in the United States.

THE PRODUCTION IN ROTARY FURNACES OF STEEL FOR CASTINGS

DISCUSSION OF PAPER AT EAST MIDLANDS BRANCH MEETING

This Paper, originally presented to the Iron and Steel Institute, was published in THE FOUNDRY TRADE JOURNAL on December 3 and 10, 1942. It was read by one of the authors, Dr. Hugh O'Neill, to a meeting of the East Midlands Branch of the Institute of British Foundrymen, over which Mr. G. L. Harbach presided. An interesting discussion followed.

An American Plant

The discussion was opened by MR. A. E. PEACE, who said he was particularly interested in Dr. O'Neill's remarks as to the possibility of using bituminous coal only in the Sesci furnace at some future time. He thought the original idea in using anthracite was to utilise the high calorific value and, further, to permit a high degree of preheated air which could be obtained by means of the recuperators. Some few years ago he saw a rotary furnace in America making steel. The main purpose of the plant was the production of malleable and graphitisable steels with something like 1.2 per cent. carbon and perhaps 1 per cent. of silicon, and the furnace had produced mild steels with 0.15 per cent. carbon. It had actually made mild steels using bituminous coal, and the opinion held was that the steel was equal in casting properties to the steel made in open-hearth furnaces. Another interesting point was that the rotary furnaces were operating on a silica-brick lining, although they had previously used a rammed lining, but he did not think they had progressed as far as the L.M.S. at Crewe had done with the technique of patching. The success of a rammed lining depended upon the success or otherwise of being able to patch. No attempt was made to patch the silica brick and the furnace was operated until the lining burned right out. They had made 180 heats per lining, which, bearing in mind the different metal, compared with the 125 which Dr. O'Neill mentioned.

One point in connection with bituminous coal was that the preheated air was only 250 deg. C., whilst with anthracite it could be much higher. He understood that this process was now a proper steel-making process, and he asked Dr. O'Neill to enlarge upon the removal of slag. Does that slag eventually become so great in quantity as to be a nuisance before the lining life of the furnace is finished? Some rotary furnaces had trunnions by means of which the slag could be removed from one end of the furnace, the furnace being charged in that position.

One very interesting feature was the reference to the particular pearlite structure. On a subsequent slide there was a formation of globular inclusions which appeared to be outlining the grains and would probably account for the cellular pearlite. He was a strong advocate of controlled grain size in steel. His experience was limited to wrought steels upon which heat-treatment had to be performed, and the grain size was of great importance. At one time his company was purchasing steels of controlled grain size, but as the war progressed this was turned down by the steelmakers and the standard heat-treatment was quite unsatisfactory. Every load of steel now received had to undergo a pilot test before the correct heat-treatment could be decided. He asked whether a method of determining grain size had been developed superseding the original method of McQuaid-Ehn.

Elimination of Anthracite

In reply, DR. O'NEILL said that the superior luminosity of the flame of bituminous coal compared with anthracite was valuable for its heat-transmitting effect, and it might be possible to save money by using bituminous coal. Unfortunately, all the time that this plant had been in use there had been a great demand for castings, and no time for experiments with possible delays or breakdowns. With regard to the slag, limestone was added quite early on in the working down of the charge, and the slag behaved in a normal way. The plant once made an ingot for Firth-Brown and the slag samples showed silica to be running about 60 per cent. most of the time, with FeO 16 per cent. and then later up to 22 per cent. The lime in the slag finished at about 5 per cent., and this was typical of steelmaking where lime additions were made. Most of the slag was removed through the tap hole after teeming, but to make repairs it was required that a certain amount of slag be retained on the lining. The slag poured off quite well and was not removed from the end of the barrel.

Mr. Peace was probably right about the network pearlite structure of the castings made and the similar formation of globular inclusions. He was glad that Mr. Peace supported the views about grain-size control, and, as he said, the heat-treatment programme could be standardised if one was getting steels with controlled inherent properties.

He noted that Mr. Peace ran a pilot test on all the steels received, and he probably knew that the Americans were running an end-quench test for a similar purpose. Regarding the question about testing for inherent grain size, his company ordered certain forging steels to be supplied to a definite grain size, but no routine test was made. The steels were judged by the mechanical behaviour of test blocks after heat-treatment. The McQuaid-Ehn method appeared to have settled down in England and America, but was not accepted in Germany. The objection was that the arbitrarily-chosen testing temperature of 925 deg. did not represent a usual heat-treatment temperature.

Expansion of Lining

MR. B. SIMPSON said an interesting point made by Dr. O'Neill was that no provision was made in the construction of the shell to take care of the after-expansion of the lining. The secret of this appeared to be in the choice of the lining material and the density at which it was rammed. How was this density attained? Were gauges used and what air pres-

Rotary Furnaces for Steel Castings

sure was applied to the pneumatic tools? He also asked if the charging was done at various points around the circumference of the shell after each heat, or if it was charged in one position all the time.

DR. O'NEILL replied that the furnace at Crewe was installed by people who trained the staff to ram the shells with a particular pisé which they were recommending. They rammed the shell as they were originally taught, but had gained some further experience. The correct moisture content and particle grading assisted in obtaining the right density.

Early Experiments

MR. E. MILLINGTON said that although he was associated with the introduction of the rotary furnace at Crewe, much had been done in the way of developing and working of the plant since his retirement. He was not therefore in a position to question or enter into any controversy, nor was there any need to do so, as the results spoke for themselves. It was very satisfactory to him to learn that all he had hoped for the plant had been confirmed, and also that the chief expected difficulty, *i.e.*, the refractory lining, had been overcome and an economic life achieved. The results were excellent, especially as regards the general quality of the steel.

Probably the history and the reason which led up to the introduction of this plant were equally of interest. At the time the main problem facing the company was the extended use of a plentiful supply of high-grade scrap; the use of 100 per cent. was visualised. Two well-known methods were in successful operation in the company's works, the open-hearth and Tropenas processes. Neither of them would, or could, use the quantity of scrap desired. Other processes were, therefore, sought. Only two possible methods seemed available:—(1) Electric furnace; and (2) rotary furnace. The electric method was ruled out on the ground of the cost of current at that time prevailing. The various types of rotary furnaces were investigated in this and European countries, and finally the Sesci method was decided upon. Coupled with this was the problem of fuel, pulverisation being essential.

Considerable thought and investigation based on the company's (L.M.S.) and other people's experience were given. The ball-mill type, with all the necessary then modern safeguards, was decided upon. The final results have now been published, which showed that this type of melting was capable of giving satisfactory material for steel castings. Whilst there were doubtless good reasons why figures were not given, he thought it might be assumed that the cost of production would compare favourably with any other process of making steel. Another favourable aspect at the present time was the use of scrap amounting to 98 per cent., thus relieving the call on the over-worked blast furnace.

Technically, the lining had presented the most difficulty, and this had been attacked from various angles. Apart from the material itself, its preparation was equally important, density playing a vital part. It would appear, and this was appreciated in the early days, that to secure the right conditions the water content, maturing and ramming must be standardised to obtain consistent results. There did not appear to be any form of apparatus available to control this operation. In any case, the practice indicated had proved satisfactory.

Fuel Considerations

Regarding the type of fuel, bituminous versus anthracite, whilst the former might have superior volatile matter, the necessary restrictions of the superheat with this class reduced the face value of the radiation given by the volatiles. So what was gained on the swings might be lost on the roundabouts. This did not mean that high volatile coals could, and must, not be used. Both types had a useful field which should be fully explored. An important point which arose and had a great influence on the character of the fuel was the size of the particles and the length of the furnace. This also involved the mixture of fuel and air and its distribution. Each particle in theory should be surrounded by the necessary volume of air if it was to burn completely in the given length. The greater the volatile, other things being equal, would probably require a longer travel period. This was a point to be borne in mind in deciding the type of fuel. This consideration introduces the question of the grid in the premixing chamber. The use of the grid was to bring about a thorough breaking up of the dust cloud and adequate mixing of air and fuel. It had the effect of reducing the length of the flame, the mesh of the grid being adjusted to suit the length of travel.

An interesting and important point had been raised in the use of aluminium in steel. This was by no means a new thing, because in the Tropenas plant at the L. & Y. Railway Company at Horwich, aluminium was used in the steel with very satisfactory results, which gave this foundry a good reputation during the last war. While grain size and Izod figures could be controlled within limits by heat-treatment, he fully agreed that the inherent grain size should be still further developed. If steel could be made more or less foolproof in regard to its properties, this should be done in preference to very fine temperature control.

Relative Physical Properties

MR. C. D. POLLARD asked if Dr. O'Neill could say whether there was any difference in the behaviour of Sesci steel in regard to feeding and its tendency to pull at a given temperature, equal to Tropenas or electric-furnace product. Would a different result be obtained in castings made from identical moulds? Further, he asked for an opinion as to the elastic limit of the Sesci steel, as compared with Tropenas or electric.

The LECTURER said that all the Crewe foundry castings were now made exclusively from this Sesci plant, and it was not possible to make direct comparisons on

the site of Sesci, with Tropenas, open-hearth or electric steel. The Crewe operators had had experience of different processes, and considered that Tropenas metal was hotter than Sesci steel and ran better. On the other hand, they believed Sesci metal to be hotter than open hearth metal, though both had similar running properties. No determinations of the actual elastic limits were made on test-bars, but the yield point was observed in a systematic way. Most people preferred a high yield ratio, but it should be appreciated that a casting with a low yield ratio had a big plastic range. The plant gave yield points on test-bars of 25 to 27 tons per sq. in. when ultimate strengths of 35 to 40 tons per sq. in. were being produced.

Patching Methods

MR. K. DOCKSEY, referring to patching, said Dr. O'Neill had mentioned that 20 per cent. of the slag was returned in the furnace, which appeared to be rather a large amount, and with such a quantity the lining would begin to run and fall away very quickly, as the slag in the rotary furnace was quite thick. Dr. O'Neill apparently obtained some high Izod values using aluminium as a deoxidising agent instead of by heat-treatment, which he had always assumed was the best method of getting high Izod values. Most Tropenas plants worked with 80 per cent. steel scrap, and due to this the yield point was about 3.5 tons higher than when operating with a high percentage hematite mixture. He was producing daily steels with 35 to 40 tons tensile with 25 tons yield point, and if that was produced in the old-fashioned way, with high percentage hematite mixture and low percentage of steel scrap, the yield point would be from 19 to 20 tons per sq. in.

DR. O'NEILL agreed that the slag in this process was on the thick side, and probably there was sometimes difficulty in sampling the steel, and certainly, if much lining had become detached, it was very difficult indeed. If 20 per cent. residual slag per patching frit was the correct figure, most of the slag must be poured out of the furnace at the end of the day, but, of course, some must remain in. The frit material was charged on to this and intense heat applied so that it coalesces properly. Quenched and tempered steels regularly carried a higher Izod value than normalised steels. As there was no necessity to quench and temper these steels, something in quality and Izod value was secured by aluminium control.

MR. R. H. BUCKLAND, referring to the use of pre-heated air with bituminous coal, said he understood the practice was to continue the use of bituminous coal until the air had reached a temperature of between 500 and 600 deg. C. If this were so, he would expect trouble with pre-ignition. He was also very interested in the grid situated in front of the burner on this Sesci furnace. Could the lecturer explain the function of this grid.

DR. O'NEILL said, in reply, that a temperature of 400 to 600 deg. C. was considered to be quite safe on this plant when only anthracite was being burnt. Substitution of bituminous coal for anthracite when starting-up commenced with an incoming air temperature of 180 deg. C., and only anthracite was being admitted shortly after that. He had not heard of any flash-backs. He was not sure of the purpose of the grid, but understood that it was supposed to be a mixer of some kind. It is a circular plate containing rectangular openings, and the Crewe people believed it to be an important matter to have these openings $\frac{7}{16}$ in. wide under their particular conditions.

Ramming Methods

MR. T. GOODWIN said the rotary furnace from a steel manufacturer's point of view really did give a very great strain on the furnace linings. The whole success of the Sesci furnace depended more than anything else upon the lining, and probably more on the ramming than anything. When the Sesci furnace was first introduced, flat-head pneumatic rammers were used, but this had now been changed. How was the material fritted in? Was it fed in by hand, and had it to be fed in very equal layers? A most important point was the moisture content; and Dr. O'Neill mentioned 6 to 7 per cent. of moisture. It had definitely been proved, however, that a lower percentage of moisture was better. Fassotte had shown that this was very important. The research carried out at the L.M.S. was going to be of very extreme value to the foundry industry, because he was fully convinced that the success and functioning of the Sesci would be more on the lines of the high-duty and malleable irons than on steels. It was possible to raise the carbon content in the Sesci furnace possibly as high as 1.3 per cent., and very much higher when making malleable irons and using no pig-iron. It could only be done within a certain period of the melt. It was useless trying to raise the carbon by "artificial methods" once the metal was molten; this was impossible, but it was possible to raise that carbon content to 2.6 per cent., using anthracite for recarburising.

There had been some discussion as to the use of bituminous coal with pre-heated air. He disagreed with Dr. O'Neill as to his figure of 400 to 500 deg. C. In the chamber immediately in front of the grid there was what was called the mixing chamber, the air and coals becoming thoroughly mixed. The amount of air behind the coal that entered that mixing chamber on the water gauge only showed $\frac{1}{4}$ in., so actually there was only sufficient air to carry the coal through the grid and there it ignited immediately, with the result that a very short intense flame was produced.

The proper working was to start with soft coal until the temperature got to 200 deg. C., and then the anthracite was introduced along with the soft coal, and as soon as the soft coal and anthracite were burning properly, the soft coal was switched off.

Dr. O'Neill thanked Mr. Goodwin for mentioning the suggestion that it was best to have less than 6 per cent. moisture. The remarks about the possibility of raising the carbon content of the bath were interesting, although in making steel there was no need to introduce carbon in that way.

(*Concluded on page* 291.)

WORLD ECONOMIC SURVEY, 1941-42

LEAGUE OF NATIONS REPORT

The League of Nations tenth "World Economic Survey," the second since the beginning of the war, covers the momentous developments from the summer of 1941 to the early autumn of 1942, including the German invasion of Russia, the Japanese conquests in south-eastern Asia and the transition to war economy in the United States. The German invasion of Russia, the Survey shows, has had far-reaching effects on economic conditions in Germany and German-controlled Europe. The Survey describes, in particular, the drain on Germany's man-power, the pressure on her transport system, the recruitment of foreign workers, the exploitation of the occupied countries, and the drastic reorganisation of the war economy in Germany itself. The picture that emerges is one of ruthless concentration of the Continent's economic resources on the requirements of war and war production. The cost in terms of human welfare stands out equally clearly. Special attention is paid to the food situation in the different European countries, the measure in which rations fall short of minimum standards, the shortages of other essential commodities, such as fuel and clothing, and the effects of these conditions as reflected in statistics of births and deaths.

A review of Russia's economic problems brings out some of the main factors that have contributed to the strength of Soviet resistance, and describes the large-scale removal of industrial equipment and labour from the threatened areas, the scorched-earth policy, and the measures adopted to increase industrial and agricultural output and to compensate for the loss of the invaded areas. The volume also deals with the important changes that have recently taken place in China, in particular the industrial development of the interior and the building up of a centralised system of taxation and economic control.

A brief account is given of Japan's strenuous efforts to increase war production at the cost of a further cut in standards of living. Japan's recent conquests, it is pointed out, have done little to alleviate her shortages of iron, steel and textiles. But they have had important economic consequences elsewhere; their effects are considered with reference not only to the raw material supplies available to the United Nations, but also to the conditions in the occupied regions themselves.

The rapid growth of war production in the United States is one of the most striking developments described in this volume. The way in which it has been achieved and the problems to which it has given rise in the civilian economy are discussed at some length. It is shown that in the short space of twelve months (from the summer of 1941 to the summer of 1942) the armament output of the United States increased five-fold, while that of the United Kingdom was doubled, so that the combined output of the two countries was approximately tripled. From about the middle of 1942, the United States surpassed the United Kingdom in the absolute volume of war production. But on a *per capita* basis Britain's war output was the highest of any nation. Comprehensive estimates are given of the curtailment in private consumption and the drafts on capital reserves that have been necessary to achieve this degree of economic mobilisation.

The various ways in which Canada, Australia, New Zealand, India and South Africa are contributing to the common war effort are reviewed, and attention is drawn to the important changes in economic and financial structure (industrial expansion, repatriation of external debt, etc.) that are taking place in these countries under the stress of war conditions.

Shipping is one of the vital problems in the United Nations' war economy, as rail transport is in the war economy of Germany. A close analysis is made of this whole transport situation—the United Nations' shipping resources and the demands made upon them, the progress of shipbuilding compared with the rate of sinkings, German requisitioning of rolling-stock, the use made of European waterways and the effect of the coal and oil shortage on European transport. The Latin-American republics have been seriously affected by the shipping shortage. The repercussions of the war on their economic life and the way in which their difficulties have been met—in particular, the assistance afforded by the United States—are considered in many parts of the volume.

The information given in the Survey is grouped by subjects as well as geographical areas, with chapters on finance and banking, price movements and price control, consumption and rationing, and international trade. The volume is obtainable from Allen & Unwin (League of Nations Publications Department), 40, Museum Street, W.C.1. (Price 12s. 6d., cloth.)

MAGNESIUM EXPANSION

It is very doubtful if the magnesium industry in Germany would have been initiated had it not been for the effectiveness of the Allies' blockade of aluminium during the last war, considers W. A. Janssen, Chief of the Metals and Minerals Unit, Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce. Once initiated the development was rapid and great during the years of preparation for the present war. During the last war five producers in the United States supplied the rather limited requirements of magnesium for flares. With the cessation of demand for these Army requirements, all but one of these producers promptly dropped the production of magnesium. One producer, however, carried on, and in 1931 had achieved the maximum production of 3,217 short tons of primary magnesium and 3,350 tons in 1939. Germany, however, in 1938 produced 15,038 tons and 18,233 tons in 1939. The current programme to meet the United States requirements for planes and incendiary bombs calls for an annual production of 362,500 tons, or more than 100 times the peak production in 1939.

NOTES FROM THE BRANCHES

London Branch.—The 70 odd members, who have joined the Branch since the war, are being asked to provide short Papers for presentation at the Annual General Meeting, to be held at 7 p.m. on April 29 at the National Liberal Club. The first prize is being offered by the President, Mr. R. B. Templeton.

London Branch, East Anglian Section.—The annual meeting was held in the Lecture Hall of the Central Library, Ipswich, on March 27, Mr. C. J. Lake presiding. The following officers were appointed for the session 1943-44:—*Section-President*, Mr. F. Tibbenham; *Vice-Presidents*, Mr. C. H. Kain and Mr. D. Carrick; *Honorary Secretary*, Mr. A. N. Sumner; *Members of Council*, Mr. A. F. Hammond and Mr. L. W. Sanders.

Mr. J. L. Francis, the retiring honorary secretary, was presented with a silver salver in appreciation of the excellent work he has done for the Section since he assumed office on its creation seven years ago. The annual report which he presented stated that a full technical session had been carried through. Four afternoons were devoted to the study of a specimen casting and another one to the showing by Mr. E. M. Currie of the Meehanite film on gating. The membership now standing at 56 showed a loss of three on the year's working. Collaboration with the Ipswich School of Engineering had been continued and good results with the foundry course were being shown. The course on patternmaking had had to be postponed owing to war conditions. The Section was well represented on the district Ironfounding Industry Fuel Committee. Mr. Lake was cordially thanked for his work as president during the past session. Following the meeting, Mr. J. W. Gardom gave an illustrated talk on the work of the Technical Committee, which dealt mainly with the production of tank links, and was on similar lines to his earlier address to the main London Branch.

THE PRODUCTION IN ROTARY FURNACES OF STEEL FOR CASTINGS

(*Concluded from page* 289.)

MR. E. HOLLAND said the first slide illustrated that waste heat was passed underneath the furnace to preheat the air. Due to this cycle of operations, could it be anticipated that the air would be hotter at the end of the furnace operation than at the commencement? Was it possible to by-pass this waste heat in any way to permit some control of the air temperature, and, if so, by what method?

DR. O'NEILL explained that the air temperature was controlled by by-passing some exhaust hot gas to the chimney to keep the pre-heat temperature within the desired limits.

The meeting terminated after Dr. O'Neill had been accorded a vote of thanks which was proposed by Mr. Pollard and seconded by Mr. J. W. Gardom.

IRON AND STEEL CONTROL

CERTAIN PRICES CHANGED

The Minister of Supply has made the Control of Iron and Steel (No. 31) Order, 1943, which came into force on April 6 and varies the (No. 15) Order:—(*a*) By substituting for the present control of "constructional steelwork for inclusion in the structure of a building" a control of "constructional steelwork" for whatever purpose it is used; (*b*) by including iron molybdate in the controlled materials; (*c*) by reducing the small quantities of iron and steel products which may be purchased free of licence; and (*d*) by amending some of the controlled maximum prices both in the Fifth Schedule and in the Related Schedules.

Below are the new Third and Fourth Schedules to the Order, containing the reduced quantities which may be acquired without authority.

THIRD SCHEDULE

Plates 3 mm. thick and thicker; sections, bars, hoop and strip (whether heavy or re-rolled, or black or bright), 1 ton in weight or £30 in value. Sheets, 10 cwts. or £20. Baling and strapping wire, 10 cwts. or £30. Coated or uncoated wire (not being baling, strapping, or barbed wire), wire strand, wire mesh, wire nails, wire staples, 4 cwts. or £16. Alloy steel bars (not including high-speed steel containing tungsten), 5 cwts. or £10.

FOURTH SCHEDULE

Ferro-alloy of any kind (except ferro-vanadium and ferro-molybdenum), 1 ton or £40. Cemented carbide hard metal, 8 lbs. or £40. Calcium silicide, 1 ton or £100. Unassorted tinplate base (uncoated), tinplate, terneplate, black plate and silver-finished plate, 13 double boxes or 1 ton 6 cwts., or £40. Cast-iron pipes and standard fittings therefor; other iron castings, 5 cwts. or £10. Wrought-iron and steel tubes and standard fittings therefor; malleable cast-iron pipe fittings, 5 cwts. or £10. Springs made either of round rod not less than $\frac{5}{16}$ in. dia., or of other material mentioned in Head 7 of the First Schedule to this Order of a corresponding cross-sectional area, and not being railway springs, 20 springs, unlimited value. Wire rope, 2 cwts. or £10.

New Related Schedules

Among the Related Schedules, Nos. 154-177, lodged under the Control of Iron and Steel (No. 31) Order, 1943, are the following; the notes give the outline of their effects:—

New schedule, L.154.—Refined malleable pig-iron: In place of the existing district prices, two prices, for north and south zones, are established in line with cylinder and refined pig-iron to which it corresponds. These prices are: North zone, £9 4s.; South zone, £9 6s. 6d.

L.155.—Low-phosphorus foundry pig-iron: Substituting one schedule of prices in place of the two existing schedules to correct zone anomalies, *viz.*, phosphorus over 0.10 per cent. to 0.75 per cent., £7 0s. 6d., Birmingham.

165.—Steel castings: Minor revisions to the existing schedule.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s each.

550,352 DANIELS, LIMITED, T. H. & J., and DANIELS, J. L. Ejector mechanism associated with the dies of die-casting machines.

550,369 WARWICK, G. Method of, and means for, casting metal to fill and enclose metal sections preparatory to bending them.

550,404 SHORTER PROCESS COMPANY, LIMITED, and SHORTER, A. E. Heat-treating apparatus.

550,434 CAPPELLA, D. D., WAKEFIELD, J. H., and COOKE, R. T. Encasements or coverings for metal joists, girders, and the like.

550,436 UNITED STEEL COMPANIES, LIMITED, and RUSSELL, G. A. V. Metallurgical furnaces.

550,442 O'SHEI, W. E. Die-casting of metals.

550,483 FEUER, E., and B. K. L. ALLOYS, LIMITED. Process for the direct production of manganese alloys by the aluminothermic method.

550,485 STEVENS, A. H. (National Lead Company). Hardened lead alloys, particularly adapted for use in bearings.

550,488 WILCOX, R. L., and WATERBURY FARREL FOUNDRY & MACHINE COMPANY. Means and method for making socketed articles.

550,505 BJORKMAN, E. B., and ESCOR INDUSTRIES, LIMITED. Methods and apparatus for granulating blast-furnace slag.

550,516 MILLS, LIMITED, W., and PAIGE, J. F. Aluminium alloys.

550,526 MEEHANITE METAL CORPORATION. Pre-heating of air supplied to cupola furnaces and the like.

550,542 PHILLIPS, A., and METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED. Manufacture of cast iron.

550,563 FRANKENTHAL, A. O., LONDON & SCANDINAVIAN METALLURGICAL COMPANY, LIMITED, and KOHNSTAMM, E. Moulds for use in pressing, die-casting, and injection-moulding operations.

550,574 LOEWY ENGINEERING COMPANY, LIMITED, and MOGILJANSKIJ, A. Suspension of rolling-mill rolls.

550,577 ACES DEVELOPMENT COMPANY, LIMITED, and FRIEDLAENDER, E. R. Powdered magnetic cores.

550,592 MEEHANITE METAL CORPORATION. Apparatus and method for pre-heating air for furnaces.

550,595 MADISON-KIPP CORPORATION. Dies for pressure casting.

550,703 BOOTH, W. E., and IMPERIAL CHEMICAL INDUSTRIES, LIMITED. Degreasing of metal articles.

550,710 POKORNY, E. A. Process for the manufacture of low-carbon ferro-alloys especially low-carbon ferro-chromium.

550,729 BIDDULPH, M., and UNIVERSAL METAL PRODUCTS, LIMITED. Collapsable metal tubes.

550,751 AMERICAN CHEMICAL PAINT COMPANY. Application of phosphate coatings to ferrous metal surfaces.

OBITUARY

MR. ARGYLL LINDSAY, a director of the Burntisland Shipbuilding Company, Limited, died on March 26, aged 69.

MR. WILLIAM GILLESPIE, late of Gauldie, Gillespie & Company, Limited, engineers, Kinning Park, Glasgow, died recently.

MR. ARTHUR THORNTON HUNTER, who died last week, aged 72 years, was formerly managing director of Alexander Jack & Sons, Limited, agricultural engineers, Maybole, Ayrshire.

MR. HARRY HUGHES, local representative of H. F. Spencer & Company, Limited, iron and steel specialists, manufacturers and stockholders, etc., of Wolverhampton, died on March 25.

MR. JAMES A. FARRELL, president of the United States Steel Corporation from 1911 to 1932, died in New York last week, aged 80. He was an honorary vice-president of the Iron and Steel Institute of Great Britain.

MR. CORNELIUS MARSHALL, who died recently at the age of 92, was for many years a director and secretary of John Russell & Company, Limited, of Walsall, iron and steel tubes and fittings manufacturers.

SIR HORACE BOOT, founder, chairman and managing director of Horace Boot & Partners, Limited, consulting engineers, died on March 31 at the age of 70. He became a Liveryman of the Cutlers' Company in 1897 and was Master Cutler in 1937.

MR. MALCOLM BLAIR, O.B.E., who died at Middlesbrough recently, aged 87, occupied executive positions with well-known engineering firms. From 1910 up to the time of his death he was with Head, Wrightson & Company, Limited, Teesdale Iron Works, Thornaby-on-Tees, of which firm he was, until some years ago, general manager and a director, and also a director of their subsidiary company, the Stockton Steel Foundry Company, Limited. Mr. Blair had a long and active connection with the foundry trade, in which he had many friends.

BARROW HAEMATITE STEEL

As already announced, the Ministry of Supply is taking over the steelworks and hoop and bar mills of the Barrow Haematite Steel Company, Limited. A few months ago the company was asked to consider a proposal for selling this portion of its equipment to the Ministry of Supply, while retaining to itself its ironworks, including blast furnaces and engineering shops, and its iron-ore mines, limestone quarries and investments. The whole plant includes a cogging mill, rail mill and merchant mill, although only the hoop and bar mills are specifically mentioned in the contract. Just prior to the war the steelmaking plant of the company included a 15-ton, four 40-ton and three 70-ton open-hearth furnaces, both acid and basic steel being made. The total cash consideration for the sale is the sum of £640,000.

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